Bringing Process to Post Production*

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Abstract. Recent developments in the field of business process management have made it possible to effectively deal with large collections of process models that exhibit many similarities but also context-dependent differences. In this paper these developments are exploited in the domain of screen business. In particular, different processes in audio editing are described in an integrated artifact, called *reference process model*, capturing their context-dependent variation points. This model can then be configured by domain experts, who are asked to select the process variants that best suit the needs of a specific audio editing project, via the use of a questionnaire. It is argued that configurable reference process models provide a structured basis for communicating the state-of-the-art in this rapidly evolving field.

Keywords: business process management, process configuration, reference model, screen business, audio editing.

1 Introduction

Traditionally, workflow management is concerned with the specification and enactment of *business processes* (Aalst and Hee 2002). Workflow management systems assist people with the various tasks that they need to perform as part of the business processes that they partake in, e.g. the clearing of a cheque or the approval of a loan application.

These systems determine *when* certain tasks need to be performed, *what* information is required as well as produced, and *who* will perform these tasks (e.g. a person or a software application). In recent years, workflow management has become a part of the area of Business Process Management (BPM) (Weske, 2007), which is not only concerned with process specification and execution, but also with other phases of the lifecycle of a business process, e.g. monitoring and diagnosis. BPM is one of the key areas of research and application in the field of Information Technology (IT), promising business benefits that include cost savings through increased efficiencies and ease of adaptation in response to market changes.

A prerequisite for a successful BPM implementation is the development of a correct and comprehensive *process model*, which formally captures the various tasks, information elements, resources, and their interdependencies. Process models can be large and complex and require input from various stakeholders. In order to manage this complexity, to guarantee compliance with typical practices and procedures, and to facilitate the construction of these models, so-called *reference models* (Rosemann and Aalst, 2007) have been introduced. Reference models are referred to as *best practice models* (Fettke and Loos, 2003) and they tend to be specific to a certain context, e.g. a certain industry or a certain country. One of the largest software providers in the world, SAP, has packaged a large set of reference process models within its Enterprise Resource Planning (ERP) suite.[1]

As reference models are specific for a certain context, similarities between different contexts can not be so easily exploited. For example, while there are differences in the production of a movie on tape or film, there are also many similarities. It is preferable to have an explicit representation of the various variation points (e.g. tape shooting vs. film shooting) as part of an overarching model. *Configurable reference models* are reference models where such variation points are explicitly indicated and they thus make it possible to provide a comprehensive picture of best practice in a fairly broad context.

In this paper we examine the construction of a configurable reference process model in the context of the *screen business* domain, in particular *audio editing* for post production. This is an area in its own right, which is

[1] SAP ERP solution, at http://www.sap.com/solutions/business-suite/erp/index.epx.

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evolving, particularly due to the emergence of new technology. While process models may serve as the basis of subsequent automated support, they can also assist with the communication of established practices and thus provide a highly structured starting point for education. Configurable reference models can highlight the various context-dependent variation points in audio editing processes and serve as a blueprint for practitioners and for tertiary education providers.

The model has been elaborated as part of a collaboration between the BPM Research Group[2] at the Queensland University of Technology and the Australian Film Television and Radio School[3] (AFTRS), within the ARC Centre of Excellence "BPM for the Creative Industries".[4] AFTRS is an Australian training and research facility for Graduate Diploma, Masters courses and short courses in Film and TV production.

In the remainder of this paper we will report and reflect on the models that were produced. Our overall objective is to convince the reader of the applicability of configurable reference process models to the field of screen business.

2 Research Method

This research project is dedicated to the development of an entire new artifact. As such, we were faced with the issue that only very limited empirical evidence was available. The research challenge required a pro-active approach in which we designed the reference process model in various iterations as rigorously as possible followed by a series of empirical validations. Consequently, the obvious reference research methodology for this research is Design Science.

Seven guidelines for Design Science were proposed by Hevner et al. (2004). One of our objectives is the design of a *purposeful artifact* (Guideline 1) that facilitates an understanding and communication of processes in the screen business and which may form the basis for improvement of these processes. We use established conceptual modeling techniques for its effective description and implementation.

Our preliminary research and explorative case studies indicated that the domain of process management in the screen business is widely regarded as *important and not sufficiently solved* (Guideline 2). We are confident that the reference model under development has the potential to change this and to contribute to more transparent and efficient processes in this industry.

The active involvement of the AFTRS provided us with sufficient access to domain experts that we utilized for the evaluation of our artifact. We used a reflective process of problem solving and thoroughly *evaluated the design* of our reference model in a number of iterations (Guideline 3).

Through this research our aim is to contribute an entirely new valuable artifact (Guideline 4), i.e. the reference process model, to the related communities. The foundation of this model is formalized and the model itself reflects the results of an iterative process in which we were seeking consensus among domain experts. Therefore, the model development process was conducted in a manner *as rigorous as possible* (Guideline 5).

Even in its current stage, our reference process model only reflects a (well-advanced) snapshot in an *ongoing search process* (Guideline 6). The model is continuously questioned, revised and extended.

Finally, we are continuously *exposing our growing artifact to scientific and professional communities* (Guideline 7) including prestigious conferences (e.g., La Rosa et al. 2007a) as well as the wide network of the Film, Television and Radio School.

3 Reference Process Modeling and Configuration

Each domain can be described by a set of business processes whose successful completion yields the achievement of a business goal. Processes of the same domain usually share commonalities but also show differences. For example, a typical post production process starts with the preparation of the footage for editing, followed by the offline editing, which is carried out on a low resolution medium. Editing first on low resolution is a common practice in this business. In fact, the amount of disk space that is taken is contained, which allows editors to handle changes faster. After this, the editing decisions are committed to a high quality format. This can vary depending on the shooting medium, which can be tape or film. Shooting on tape may involve online editing, while shooting on film implies negmatching, which consists in cutting the motion picture negative to precisely match the offline editing. Therefore, experts involved in a post production project (e.g. a director), adhere to one of these two practices, depending on the requirements of the project.

Therefore, shooting on tape and shooting on film are two variants of the same business process. These variants can be represented in an integrated artifact, which is called *configurable reference process model*. Figure 1 shows a simplified version of the tape shooting and of the film shooting business processes as a sequence of activities.

[2] BPM Research Group, at http://www.bpm.fit.qut.edu.au.
[3] AFTRS, at http://www.aftrs.edu.au.
[4] More details on the project can be found at http://www.bpm.fit.qut.edu.au/projects/coe.

The commonality between the two processes is represented by the first two activities (*Prepare footage for editing* and *Offline editing*), while the variability is represented by the cut stage (*Online editing* for tape and *Negmatching* for film).

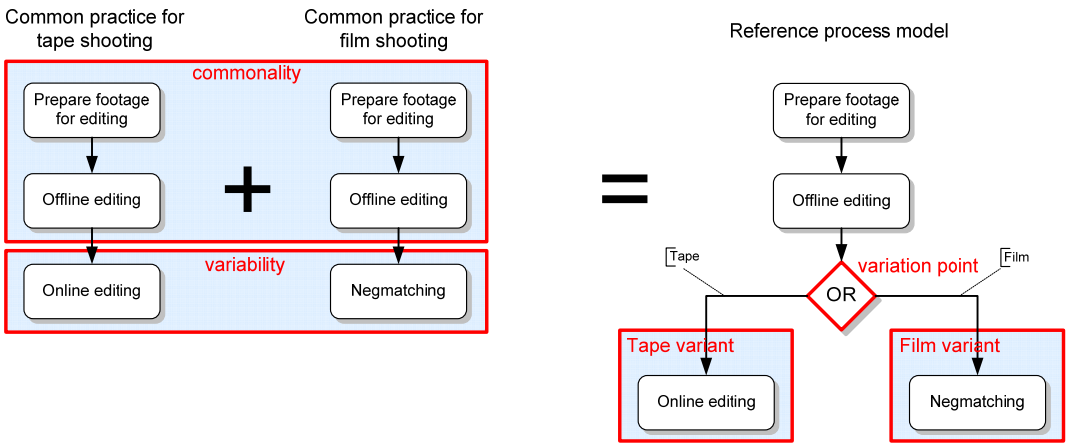

Fig. 1 A reference process model is an integrated representation of multiple variants of a business process.

The reference process model, depicted on the right in Figure 1, incorporates both the variants by means of an OR gateway after activity *Offline editing*. This is a *variation point*, i.e. a point in the process in which a decision needs to be taken, whether to choose the tape variant (left-hand side branch) or the film variant (right-hand side branch). In a reference process model, variation points are explicitly represented by means of e.g. graphical aids, and associated with a set of variants. Clearly, there can be many variation points, depending on the degree of variability of the given domain. The selection of the most suitable variant for each variation point is called *configuration*. Once all the variation points have been configured, an *individualized* reference process model can be obtained from the reference process model (e.g. by dropping some branches), through a process called *individualization*. The derived model can then be used as a blueprint to document the process followed in a specific project, while the reference process model can be used to document the whole range of options that are available.

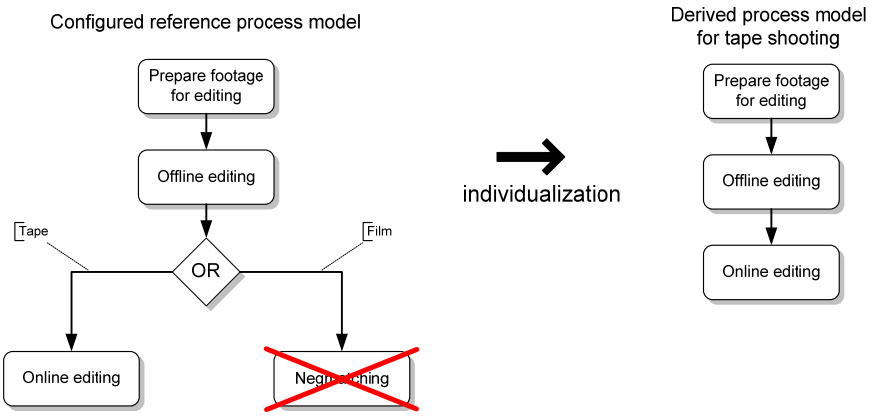

Fig. 2 Reference process models are intended to be configured to the requirements of a specific organization or project.

3.1 The Questionnaire Interface for Process Configuration

The choice between online editing and negmatching is affected by the type of medium. However, there can be other factors, such as the project's budget level or the distribution channel, influencing this choice. For instance, negmatching is usually a costly operation and hence it is uncommon for low budget productions, while tape is the preferred format if the project releases for TV. Such interdependencies are translated in the reference process model into a set of constraints restricting the allowed variants each variation point can take. When there are many variation points involved, these constraints can become complex and intricate. As a consequence, configuring the reference process model can be difficult and time-consuming. Moreover, while it is normal to assume that the modellers who build the reference process model are familiar with process notations, it is less realistic to assume that those who provide input for configuring these models (e.g. a screen director) are sufficiently proficient with the notation.

In order to tackle these issues, we developed a framework based on the use of questionnaires as interfaces to configure reference process models. For instance, a question in post production could be *"How is the picture cut to be performed?"*, with answers *"online editing"* and *"negmatching"*. We organize the questions in a questionnaire model, which is then fed into an interactive questionnaire tool. The tool provides contextual guidelines and advice to answer the questions. As the user answers the questionnaire, the reference process model is configured and once the questionnaire has been completed, an individualized version of the reference process model is produced. The advantage is that in this approach communication with the user is in terms of domain concepts, and there is no need to deal with the modeling notation in which the configurable model has been represented. A screenshot of the questionnaire tool[5] developed as part of this research is shown in Figure 3.

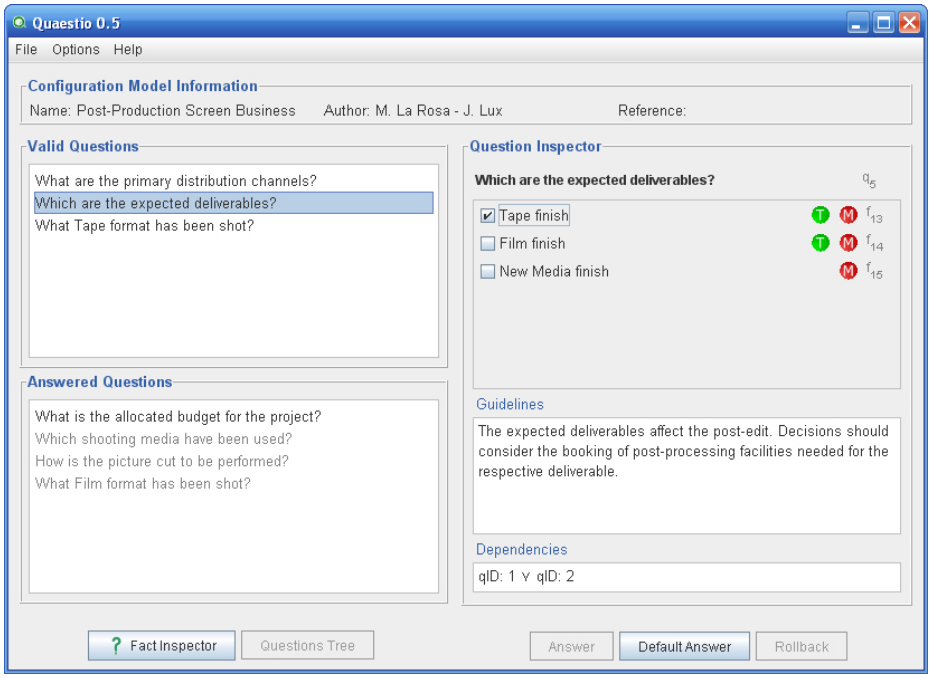

Fig. 3 The questionnaire tool, used to configure reference process models.

4 The Sound and Music Post Production Reference Process Model

We constructed and validated a reference process model for sound and music editing in post production, in collaboration with subject-matter experts of the AFTRS.

Sound and music editing concerns the capture, design and manipulation of music, dialogue, effects and atmospheres for a film, TV or other media project (Wyatt and Amyes, 2004). Dialogue includes the original lines spoken by the actor. Effects can range from simple footsteps to complex hurricanes. Atmospheres are the environmental sounds, such as the general noise in an office or the wind in the desert. The Sound design brings together the digitised sounds from set, and where necessary will re-record elements (e.g. when a dialogue is inaudible). Once all the elements are edited and approved by the various stakeholders, the mix phase can take place. This involves balancing volume and frequency in the overall design. When mixing is complete the files are joined to the final picture and the sound licence is obtained.

We chose this domain for the high level of creativity, and thus of variability, that characterizes post production. For example, the number of personnel involved depends greatly on the type of project. In an animation movie, the dialogue is often recorded before the characters are finalised, and scenes are complete. In a small budget feature film, the design and editing begins once the picture editing is complete, and is carried out by a single sound designer. On a big budget feature film, the sound department can be 30 or more personnel and may still be happening while the picture is being finalised.

The reference process model for audio editing is shown in Figure 4. It was constructed over a five-month period, in which a series of interviews were conducted with Mark Ward, the Head of Sound at AFTRS. Firstly, we established the order in which the tasks are executed in the process (so-called "control-flow"). Secondly, we identified the objects used and produced by each task (examples are the film roll, the dialogue tracks).

[5] The tool can be downloaded from www.processconfiguration.com.

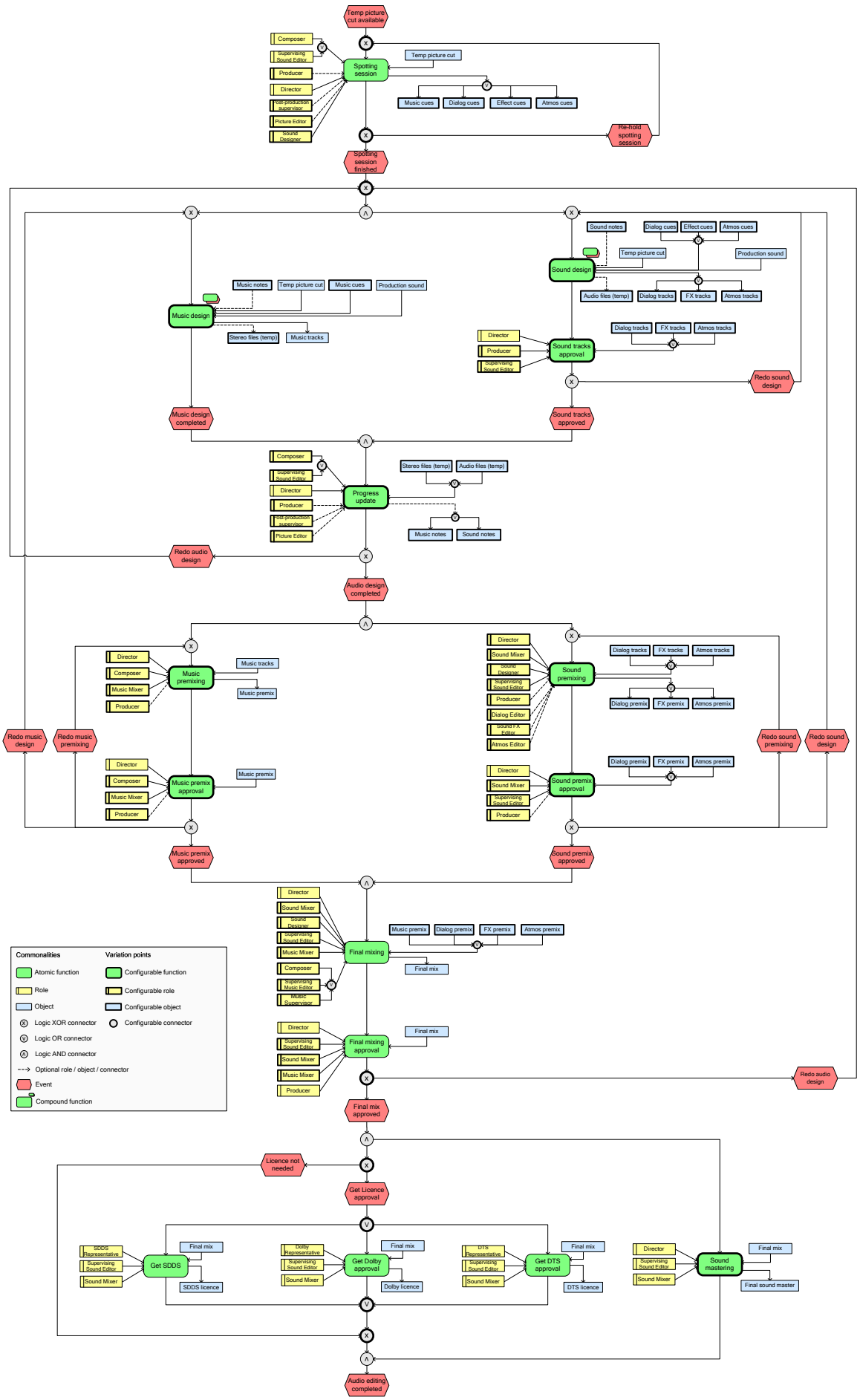

Fig. 4 The reference process model for music and sound editing in the C-iEPC notation.

Thirdly, we assigned to each task the human roles that have to perform them (the director, the sound designer, etc.). Afterwards, we identified variation points in the process model, in terms of which tasks, objects and roles can vary.

To capture all these aspects, we introduced a new process notation, called Configurable integrated Event-driven Process Chains (C-iEPCs) (La Rosa et al., 2007b) as an extension of the C-EPC notation (Rosemann and Aalst 2007). C-iEPC's elements are events, functions and connectors linked by arcs. Functions correspond to activities that need to be carried out, e.g. Spotting session, and are associated to roles and objects. For example, the Director and the Producer are two roles required to carry out the Spotting session. Objects can be input, if required by the function, or output, if produced by the function. For instance, the Spotting session requires the Temp picture cut from the set and produces the Music and Sound cues. Events model states of the process, e.g. an event is used to model the completion of the Spotting session.

In C-iEPC, a variation point is represented by an element with a thicker border, and indicates that the element can be dropped from the model if not needed. Connectors, functions, roles and objects can be variation points. Figure 5 focuses on function Sound premix approval. Here several elements are configurable: the function itself, its roles Sound Mixer, Supervising Sound Editor and Producer, and all the input objects. For example, the Producer may not participate in this activity. Usually this is a choice in high budget projects, where there are other roles with creative authority, like the Supervising Sound Editor, that takes care of approving the sound premix. Also, it is possible to decide which tracks have to be premixed among sound, effects and atmospheres, on the basis of the project requirements. There are in fact movies that do not feature any audio effects (silent films such as Metropolis or the work of Buster Keaton), and others without spoken dialogue (examples are The Thief, Baraka, The Red Balloon). Finally Sound premix approval can be skipped if the project only features music (in this case all the associated roles and objects are dropped altogether and this implies the removal of the Sound premix as well).

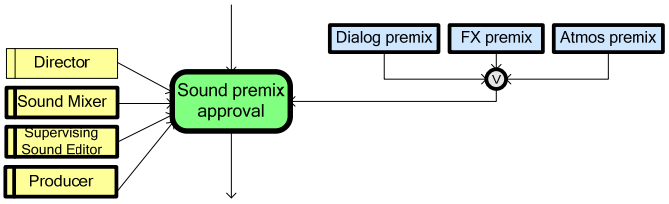

Fig. 5 The configurable function Sound premix approval.

In a second stage, we defined a set of questions for the music and sound editing reference process model. Besides general questions regarding post production (e.g., on the budget and on the distribution channel), we defined questions about more specific aspects of music and sound editing. For example, the music and audio tracks to be used, the chosen audio formats, the option to have a spotting session, the roles participating in the editing.

The questionnaire has been used to configure the reference process model for the student projects at the AFTRS. For example, AFTRS' short-form dramas typically include music, dialogue, atmospheres and some sound effects. Sound files are digitised once filming is complete and some preliminary editing and design begins by the student Sound Designer. The spotting session is held with the Director, the Sound Designer and the Composer to indicate the cues for sounds and music. Once the music, dialogue, effects and atmospheres have been edited and approved by the director, the Composer and the Sound Designer can prepare the elements for the mix. Music and sound premix are only approved by the Director and the Producer. After that, the final mix of sound and music takes place, which is carried out by the Director, Sound Designer and Composer. The final mix is approved by the Director and the Producer and then delivered to the picture department to be matched to the final picture. This process model, which has been automatically derived from the reference process model via the questionnaire tool, is shown in Figure 6.

This shows that depending on the context, a customized process model can be generated by domain experts in a straightforward manner. The generated model can then guide the planning and the actual execution of a screen project. The model captures which tasks need to be performed and when, the participants that are involved, and the objects that are required and produced.

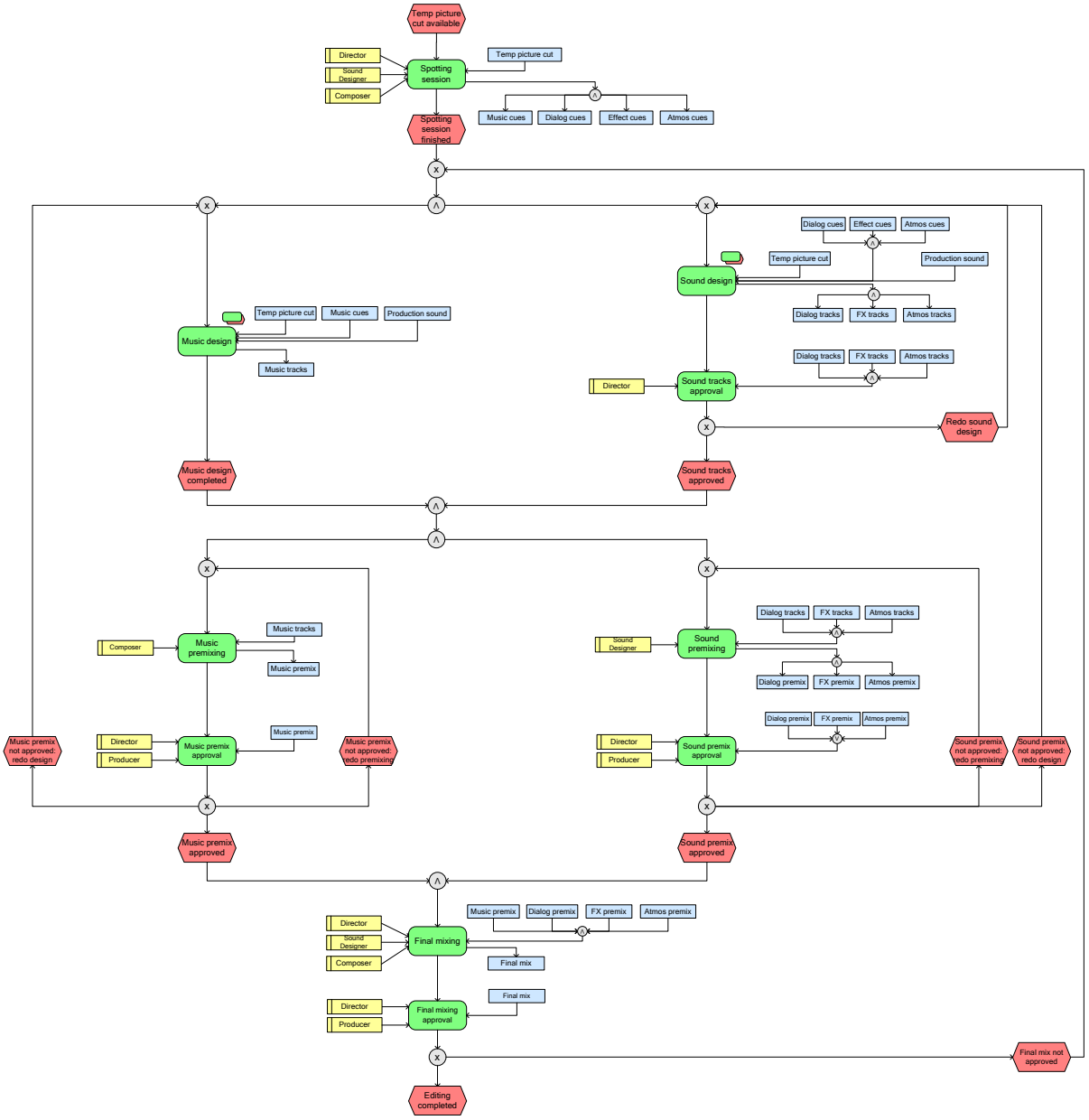

Fig. 6 The music and sound editing process for short-form dramas followed at the AFTRS.

5 Epilogue

In collaboration with the AFTRS a configurable reference process model for post production was constructed and validated. Through configuration of this model, situation-specific post production models can be generated (e.g. for a low budget movie which is only distributed on DVD). An interactive questionnaire was implemented allowing stakeholders, e.g. a producer, to do this configuration without the assistance of an IT expert.

The reference model can be used as a tool for communication within the industry or within the learning environment. In the most early development stage, the Producer could use the model to assist with initial budgeting for finance raising purposes. A Production Manager, a Producer and a Post Production Supervisor could also use the configurable model when planning schedule, booking facilities and crew. Due to the daily alterations to budgets and schedules, a system that can offer numerous alternatives and options for a Producer would be time saving and more precise than running numbers on a piece of paper.

A great deal of the work done in pre production is the communication between departments about what they require in terms of time, budget and resources. This is a complicated back and forth between departments in an attempt to find a balance between cost and creativity. The tool can assist in making transparent individuals' respective processes and enable greater clarity when negotiating on time frames and costing, or as a tool when readjusting time lines.

In the learning environment, the model can be used when teaching students about the stages of the post production process. This is useful for students who aspire to become editors, sound designers and screen composers. Furthermore it can be useful for producing and directing students to clearly map the post production chain of events.

In this ever-changing environment, where practices vary from one project to another and where technology innovation plays a fundamental role, AFTRS aims at providing the student with a set of best practice scenarios. These best practices have been the input for the construction of the reference model. Working with a post production company would likely have led to results that are quite specific to the company's practices which would not have lend themselves to generalizations. However, in order to really determine the applicability of the reference process model and its questionnaire, further validation with AFTRS' staff and students, as well as with practitioners, is necessary. How to approach this is an interesting research issue in itself. For example, we envisage that the experimental set up should take into account the different level of expertise of the participants.

Finally, an issue which may be worth further exploring is that of representation of tacit knowledge (Polanyi, 1966), i.e. whether the reference model indeed captures all essential ingredients or whether some of them exist in the domain experts' mind only.

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